METHOD OF GENERATING BITMAP OF THREE-DIMENSIONAL MODEL, DEVICE AND SYSTEM FOR PERFORMING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2015-0108282, filed on Jul. 30, 2015, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] 1. Field

[0003] Embodiments of the present disclosure relate to a three-dimensional printing technology.

[0004] 2. Discussion of Related Art

[0005] Early three-dimensional printers were mainly used in producing prototypes, but as printers capable of outputting various colors and materials come out, the application area widens. Particularly, a multi jet modeling (MJM) method capable of outputting with high precision, multiple colors and multiple materials has come into the spotlight.

[0006] However, in order to output an object including multiple colors and multiple materials with high precision, a very complicated process of preprocessing (i.e., slicing) is required. For example, assuming that a resolution of the printer is 600 dots per inch (DPI), about one hundred million three-dimensional unit pixels (i.e., voxels) per cubic meter exist. Therefore, a slicing process which includes converting an input model into voxel units, assigning attributes such as color and material to each voxel, and generating bitmaps of two-dimensional stacked planes needs a lot of operation time due to a large amount of calculation.

[0007] Here, a parallelization process of the slicing process is required to reduce an operation time, but there is a problem in which parallelization of the slicing process is difficult when a support material region is included in a bitmap of a stacked plane, as in the MJM method. That is, to obtain the support material region in a particular stacked plane, information on all the stacked planes over the corresponding stacked plane should be known. Therefore, it is hard to independently perform a process of obtaining the support material region of each stacked plane, and therefore it is hard to parallelize the slicing process.

SUMMARY

[0008] Exemplary embodiments of the present disclosure are directed to a method of generating bitmaps of a three-dimensional model capable of reducing time required for a slicing operation, and a device and a system for performing the method.

[0009] According to an aspect of the present disclosure, a bitmap generator of a three-dimensional model includes a model divider configured to divide the three-dimensional model into a plurality of sub models, wherein the three-dimensional model is divided in a direction parallel with an output direction of a three-dimensional printer, a plurality of sub bitmap generators each configured to generate a sub bitmap for a plane perpendicular to the output direction for the plurality of sub models, an operation distributer configured to transfer and distribute the plurality of sub models to the plurality of sub bitmap generators so that operations of generating the sub bitmaps are processed in parallel, and a bitmap adder configured to merge the sub bitmaps whose coordinates of the output direction are the same among the generated plurality of sub bitmaps.

[0010] The model divider may divide the three-dimensional model so that the number of space elements included in each of the plurality of sub models is constant.

[0011] The model divider may divide the three-dimensional model so that widths of the plurality of sub models are equal.

[0012] Each of the plurality of sub bitmap generators may rasterize each of the plurality of sub models in a direction perpendicular to the output direction, and may determine a type of each pixel generated by the rasterization based on a location relationship with an outline of each of the plurality of sub models.

[0013] Each of the plurality of sub bitmap generators may determine a pixel existing on the outline or inside the outline as a pixel corresponding to a part material region.

[0014] Each of the plurality of sub bitmap generators may determine a pixel existing outside the outline based on the output direction as a pixel corresponding to a support material region.

[0015] The bitmap generator may further include an operation adjuster configured to redistribute operations of generating the sub bitmaps based on a processing degree of the operation of generating the sub bitmaps of the plurality of sub bitmap generators.

[0016] The operation adjuster may monitor a remaining degree of operation of the plurality of sub bitmap generators, and may reassign a part of an amount of operation of a sub bitmap generator in which the operation of generating the sub bitmaps is not completed to a sub bitmap generator in which the operation of generating the sub bitmaps is completed.

[0017] When a sub bitmap generator in which the operation of generating the sub bitmaps is completed exists, the operation adjuster may check whether a sub bitmap generator in which an amount of a remaining operation is equal to or more than a predetermined critical value exists among sub bitmap generators in which the operation of generating the sub bitmaps is not completed, and may reassign a part of an amount of operation of a sub bitmap generator in which the amount of the remaining operation is equal to or more than the predetermined critical value to the sub bitmap generator in which the operation of generating the sub bitmaps is completed.

[0018] According to another aspect of the present disclosure, a method of generating bitmaps of a three-dimensional model includes dividing, in a bitmap generator, the three-dimensional model into a plurality of sub models in a direction parallel with an output direction of a three-dimensional printer, distributing, in the bitmap generator, operations of generating sub bitmaps so that the operations of generating the sub bitmaps for the plurality of sub models are processed in parallel, generating, in the bitmap generator, a sub bitmap for a plane perpendicular to the output direction for each of the plurality of sub models, and merging, in the bitmap generator, the sub bitmaps whose coordinates of the output direction are the same among the generated plurality of sub bitmaps.

[0019] The dividing of the three-dimensional model may include dividing, in the bitmap generator, the three-dimen-